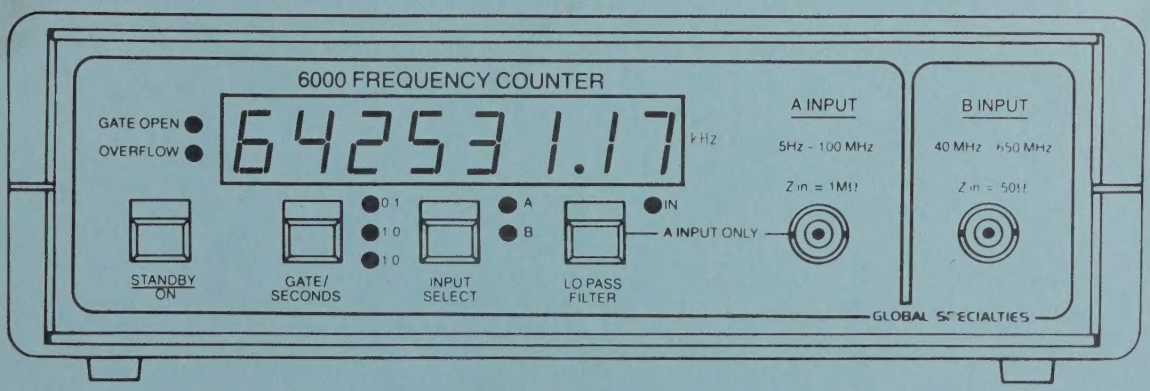
6000 650 MHz FREQUENCY COUNTER

instruction manual



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6000 SPECIFICATIONS (See FIGURES 1-5)

INPUTS: 2 inputs, A and B, AC coupled, BNC connectors

A INPUT:

Impedance 1 MΩ @ 25 pF

Response <5 Hz to >100 MHz

Sensitivity 10 mV_{RMS} - 5 Hz to 1 MHz; 25 mV_{RMS} - 1 MHz to 50 MHz; 40 mV_{RMS} - 50 MHz to 100 MHz

Max. Input Voltage 280V_{RMS} - 5 Hz to 160 Hz; 120V_{RMS} - 160 Hz to 16 kHz; 14V_{RMS} - 16 kHz to 470 kHz; 7V_{RMS} - 470 kHz to 100 MHz

B INPUT:

Impedance 50Ω @ 10 pF

Response <40 MHz to >650 MHz

Sensitivity 50 mV_{RMS} - 40 MHz to 100 MHz; 100 mV_{RMS} - 100 MHz to 600 MHz; 150 mV_{RMS} - 600 MHz to 650 MHz

Max. Input Voltage ±5V_{pk} - 40 MHz to 650 MHz

REFERENCE: Timebase 3.579545 MHz crystal oscillator, ±4 ppm from 0-40°C ambient. Aging <4 ppm/year.

Optional timebase 3.579545 MHz crystal oven oscillator ±0.1 ppm from 10-40°C ambient, oven temperature 55°C. Aging <1 ppm/year.

ACCURACY: ±(timebase error) x frequency ±trigger error ±1 LSD

Trigger error = $\frac{\text{peak-to-peak noise voltage on input}}{\text{signal slope (V/S)}}$

CONTROLS: Standby/On, Gate Time Select (0.1, 1.0, 10s), A/B Input Select, Lo Pass Filter In/Out.

DISPLAY: 8-digit, 7-segment, 0.43 inch LED display, decimal point indicates frequency in kHz, leading zero blanking; discrete "Overflow" (counter overflow) and "Gate Open" LEDs.

POWER: 105-135 VAC, 57-63 Hz, 15 VA maximum (215-250 VAC, 50-60 Hz version available). Standby power 6 VA maximum.

DIMENSIONS: 3x10x7 inches HxWxD (76x254x178 mm), 3.5 lbs (1.6 Kg)

OPERATING TEMPERATURE: 0-40°C

INCLUDES: Instruction manual

STOCK NO: 105-6000 (for oven oscillator option order 105-6500)

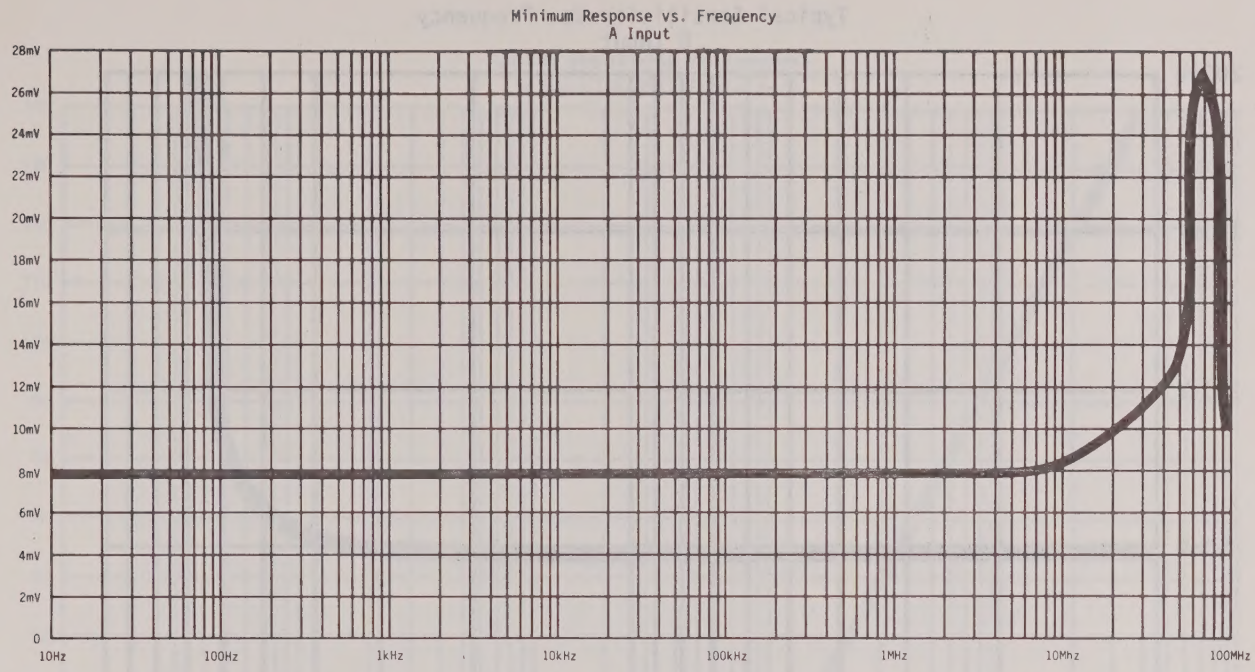


FIGURE 1

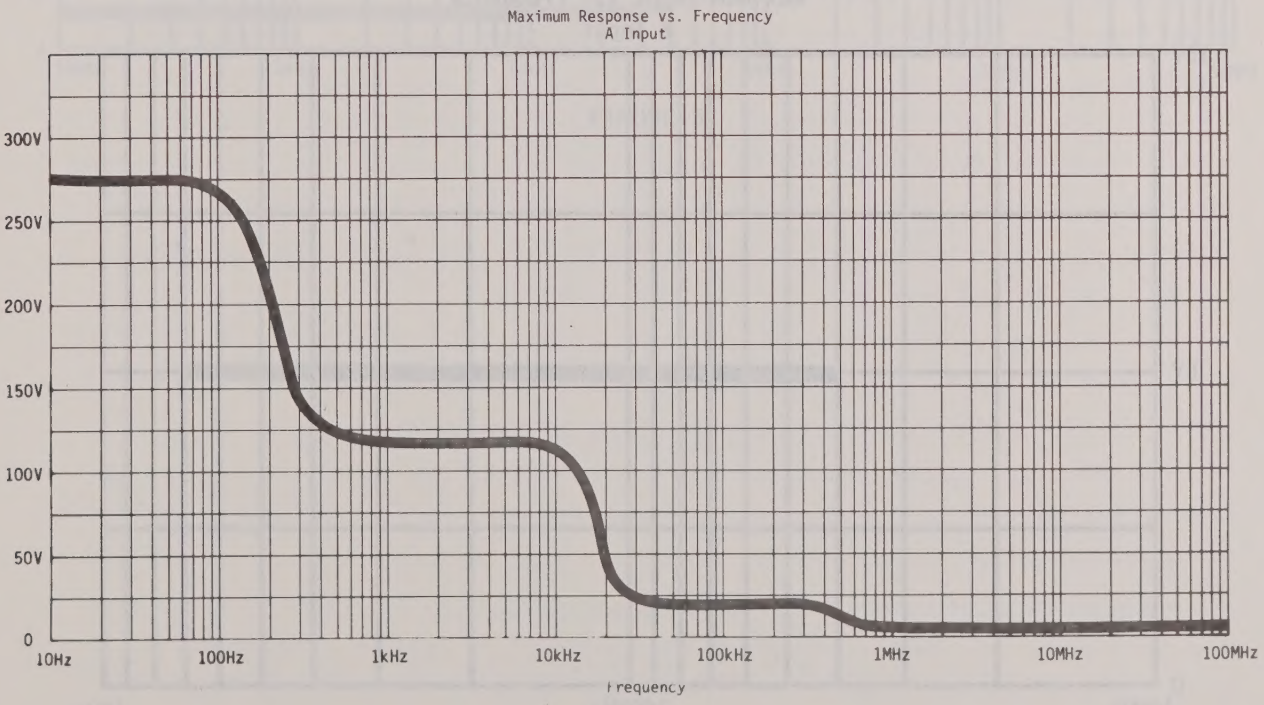


FIGURE 2

Typical Sensitivity Vs. Frequency
B Input

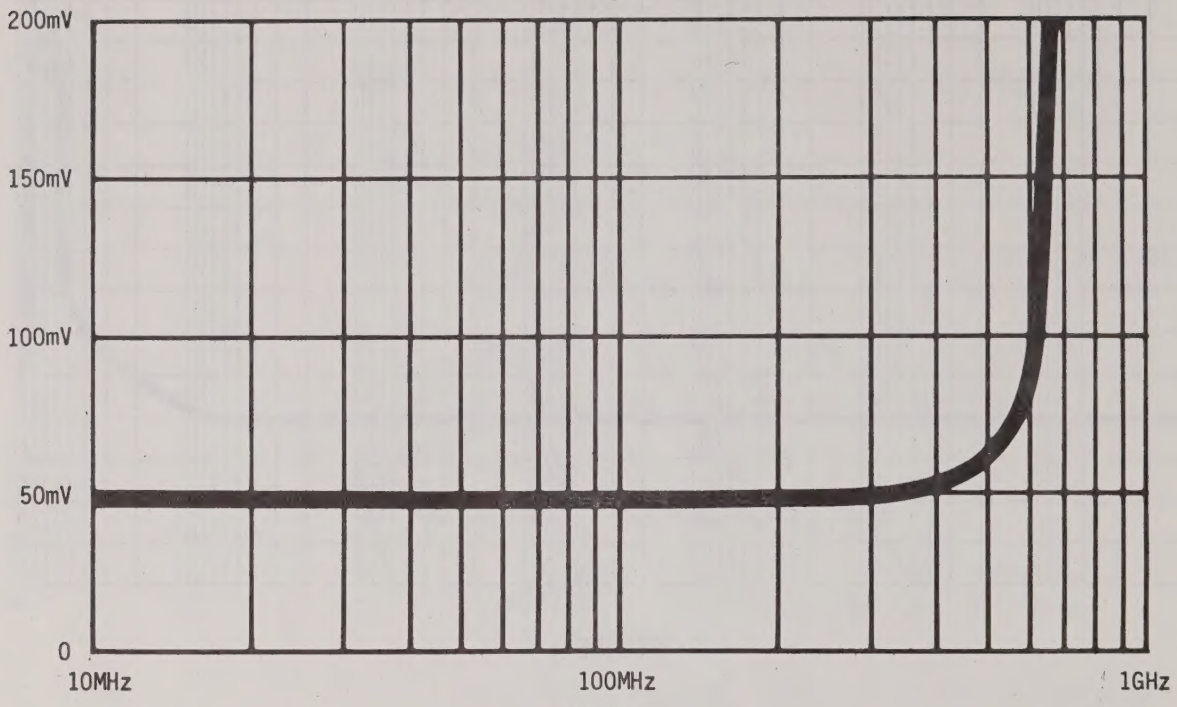


FIGURE 3

Maximum Input vs. Frequency
B Input

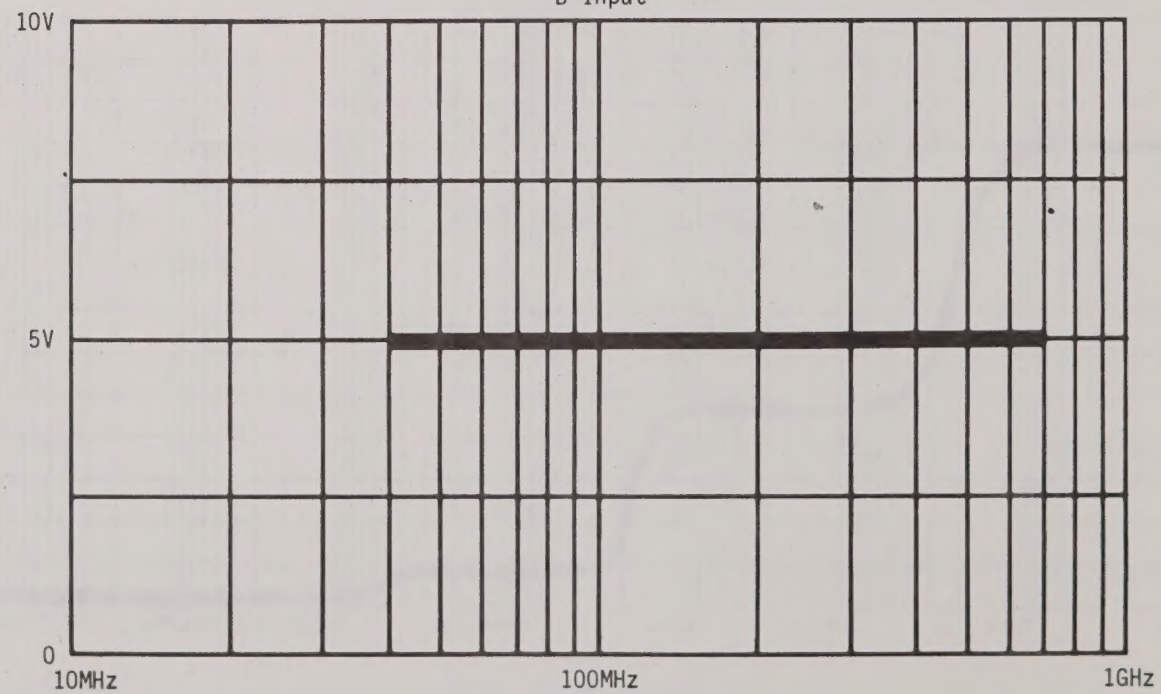


FIGURE 4

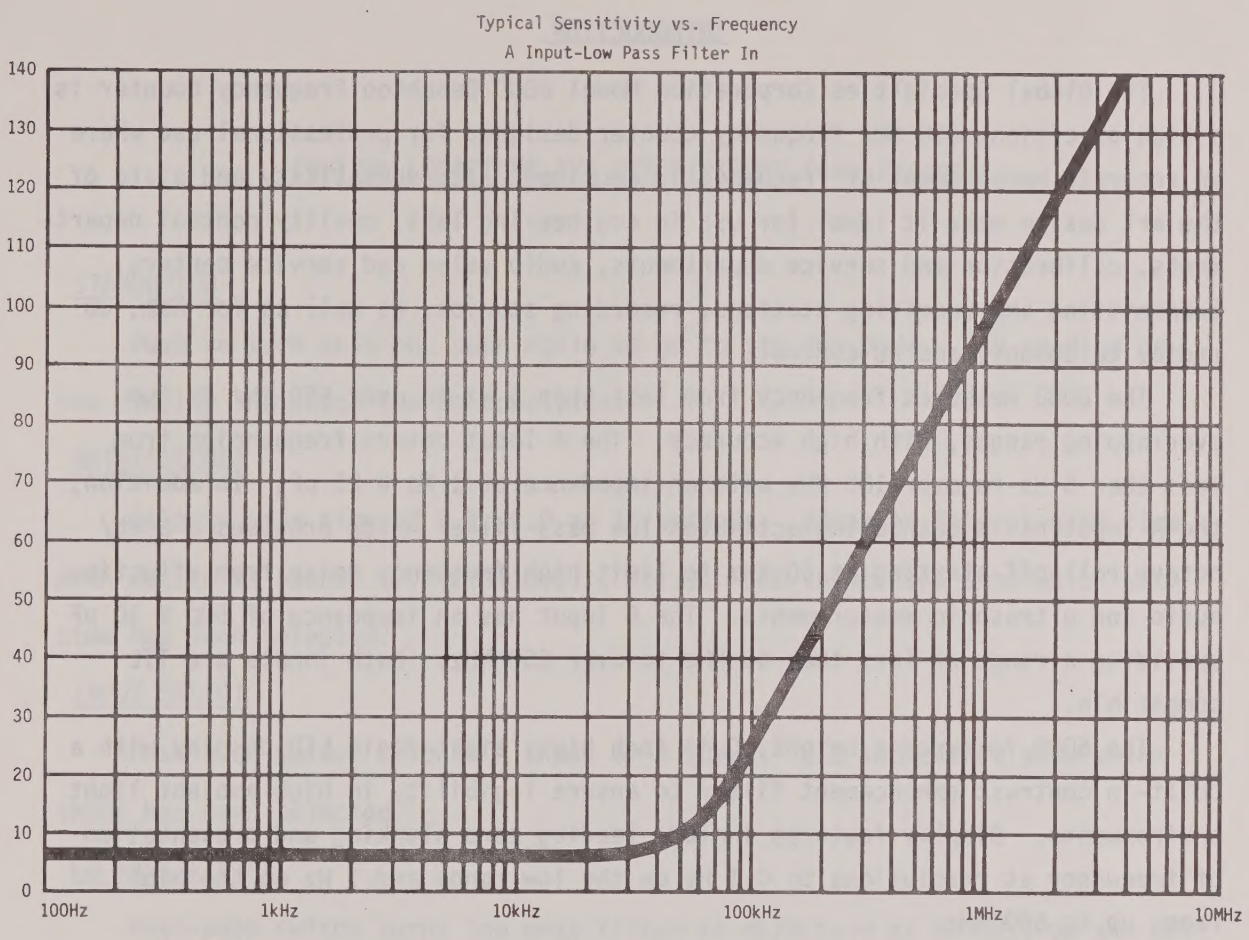

Typical Sensitivity vs. Frequency
A Input-Low Pass Filter In
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
100Hz
1kHz
10kHz
100kHz
1MHz
10MHz

FIGURE 5

INTRODUCTION

The Global Specialties Corporation Model 6000 Benchtop Frequency Counter is a high precision, 650 MHz frequency counter designed for professional use where an accurate measurement of frequency is required. Its versatility and state of the art design make it ideal for use in engineering labs, quality control departments, calibration and service departments, audio sales and service centers, transmitting and receiving stations, recording studios, as well as for ham, CB radio, telephony, and RC control.

The 6000 measures frequency from less than 5 Hz to over 650 MHz in two overlapping ranges, with high accuracy. The A Input covers frequencies from less than 5 Hz to over 100 MHz with an impedance of 1 MΩ @ 25 pF. In addition, the A Input has a pushbutton-activated low pass filter which provides a 6 db/ octave roll-off starting at 60 KHz to limit high frequency noise from affecting audio and ultrasonic measurements. The B Input has an impedance of 50Ω @ 10 pF providing a range of less than 40 MHz to over 650 MHz. Both inputs are TTL compatible.

The 6000 features a bright, 0.43 inch high, eight-digit LED display with a built-in contrast enhancement filter to ensure legibility in high ambient light environments. Display features include leading zero blanking and presentation of frequency at resolutions to 0.1 Hz on the low range and 1 Hz on the high range up to 650 MHz.

For ease of use, the front panel controls have been kept to a minimum. They include three pushbutton-selectable gate times providing 0.1, 1.0, and 10 second intervals, an input selection control (A Input or B Input) and a pushbutton-activated low pass filter, all with LED indicators. Two other LED indicators are included to indicate gate and overflow functions.

The internal timebase for the 6000 is a precision 3.579545 MHz crystal oscillator with an accuracy of ±1 ppm from 0-40°C. The optional crystal oven oscillator version provides an accuracy of ±0.1 ppm from 0-40°C.

In order to improve timebase stability, a STANDBY/ON switch is used rather than an OFF/ON switch. In the Standby mode, the oscillator (and oven) remain in operation while the rest of the circuitry is unpowered.

Typical applications include measuring transmitter frequency, testing and repairing audio equipment, measuring RPM, testing and repairing broadcast equipment, checking FCC compliance to transmission variance, calibrating signal generators and test equipment, telephony, measuring microprocessor timebases, etc.

CONTROL LOCATIONS AND DESCRIPTIONS (see FIGURE 6)

STANDBY/ON

Push to turn unit on, push again to go to standby mode. Any reading on the display indicates the ON condition.

GATE/SECONDS

Selects gate time of 0.1, 1.0 or 10 seconds. Advances to next gate time when button is pushed (0.1→1.0→10→0.1, etc.). LED indicators show which gate time has been selected.

INPUT SELECT

Push-push switch selects A Input or B Input. LED indicators show which input has been selected.

LO PASS FILTER

Push-push switch turns low pass filter (6 db/octave at 60 KHz) on and off for signals at A Input only. LED indicator lights when filter is active.

DISPLAY

Eight digits. Leading zero blanking. Decimal point formats display of frequency in kilohertz.

GATE OPEN

Lights to indicate that measurement cycle is in progress, goes dark between measurement cycles.

OVERFLOW

Lights to indicate counter overflow when the counter's range has been exceeded. (See Operating Instructions for overflow conditions.)

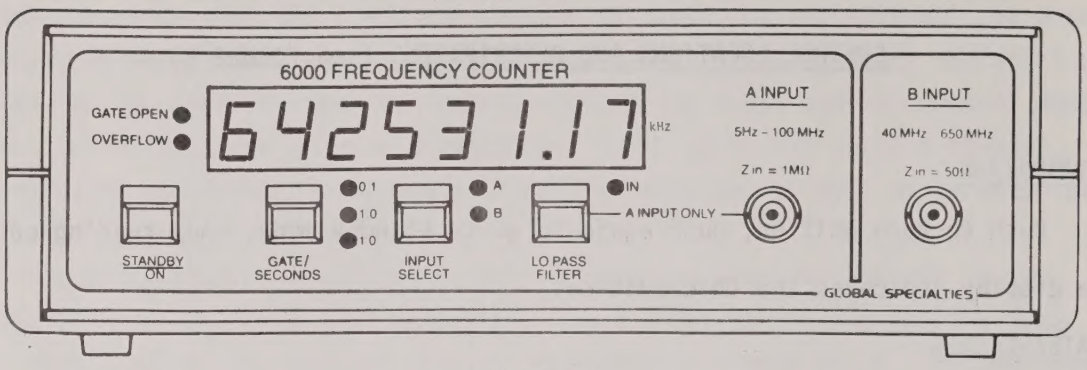


FIGURE 6

INITIAL INSPECTION AND CHECKOUT PROCEDURE

In order to accomplish the initial inspection of the Model 6000 Frequency Counter, the following equipment is required:

1. A grounded (three-prong) 50/60 Hz AC outlet of the correct voltage (110/220 VAC).
2. A signal generator (or generators) covering the range of 1 Hz to 650 MHz, with appropriate terminators.
3. At least one coaxial cable terminated with BNC connectors at both ends (Global Specailties Model PSA-2 or equivalent).

Procedure

NOTE: All readings are ±1 LSD. Signal generator should be properly terminated.

1. Plug the 6000 into the outlet; unit should be in the standby mode, with all indicators off. Push the STANDBY/ON switch once. Unit should activate with 0.1 second gate time, A Input active, and Lo Pass Filter out. Display should read 0.00. Allow unit to idle for at least one-half hour.
2. Observe the GATE OPEN LED. It should flash rapidly, blinking several times a second.
3. Select the 1.0 second gate time. The GATE OPEN LED should now remain on for one-second intervals.

4. Select the 10 second gate time. The GATE OPEN LED should now remain on for 10 second intervals.

5. Adjust the signal generator for a 10 mV_{RMS} sine wave at 5 Hz.

6. Connect the output of the generator to the A Input of the 6000. Select the 1.0 second gate time. The display should read 0.005.

7. Adjust the output of the generator up to 1 MHz. The 6000 display should continue to follow the output of the generator. You may wish to select the 0.1 second gate time for faster display updating.

8. Set the output of the generator to 100 kHz @ 10 mV_{RMS} . Enable the LO PASS FILTER by pushing the button. The display should go to 0.000 (with 1.0 second gate time selected). Disable the LO PASS FILTER by pushing the button again.

9. Adjust the generator for an output of 40 mV_{RMS} at 100 kHz and connect it to the A Input of the 6000. For fastest updating, select the 0.1 second gate time.

10. Adjust the frequency of the generator upward from 100 kHz to 100 MHz, observing that the frequency is continually tracked, updated and displayed on the 6000.

11. Adjust the generator to a frequency between 1 MHz and 9.9 MHz. With a 0.1 second gate time selected, the display format will be XXXX.XX (frequency in kHz, 10 Hz resolution). Select the 1.0 second gate time; the display format should be XXXX.XXX (frequency in kHz, 1 Hz resolution). Select the 10 second gate time and wait about 10 seconds; the display format should be XXXX.XXXX (frequency in kHz 0.1 Hz resolution).

12. Select the 0.1 second gate time and adjust the generator to a frequency between 10 MHz and 99 MHz.

13. Select the 10 second gate time. After about 10 seconds the OVERFLOW LED should light and the most significant digit (tens of MHz) should not be visible; the display, however, should accurately include eight least significant digits.

14. Adjust the generator for an output of 100 mV_{RMS} at 40 MHz and connect it to the B Input of the 6000. Select the B Input.

15. Adjust the frequency of the generator upward from 40 MHz to 500 MHz, observing that the frequency is continually tracked, updated and displayed on the 6000.

16. Adjust the RF generator to a frequency between 40 MHz and 99 MHz. With a 0.1 second gate time selected, the display format should be XXXXX.X (frequency in kHz, 100 kHz resolution). Select the 1.0 second gate time; the display format should be XXXXX.XX (frequency in kHz 10 Hz resolution). Select the 10 second gate time and wait about 10 seconds; the display format should be XXXXX.XXX (frequency in kHz 1 Hz resolution).

17. Select the 0.1 second gate time and adjust the generator to a frequency between 100 MHz and 600 MHz.

18. Select the 10 second gate time. After about 10 seconds the OVERFLOW LED should light, and the most significant digit (hundreds of MHz) should not be visible. The display, however, should accurately include eight least significant digits.

19. Adjust the generator for an output of 150 mV_{RMS} at 600 MHz.

20. Select the 0.1 second gate time. Adjust the output of the generator upward from 600 MHz to 650 MHz; the 6000 should display double the frequency of the generator.

21. Disconnect all cables and press STANDBY/ON button. This completes the initial inspection and checkout of the 6000.

Precautions

1. Do not connect the 6000 directly to a transmitter or transmission line. There is no load or other form of line termination provided within the 6000. To measure transmitter output frequencies, you must use an antenna to sample transmitter RF so that the output does not exceed the maximum input specification of the 6000. (See Applications: "Measuring Transmitter Frequency").

2. Do not apply any signal to any input greater than its maximum specified input voltage. Do not switch the LO PASS FILTER in or out with more than 120 VAC applied to the A Input. The input should first be removed, then the switching done, then the signal reapplied.

3. For greatest accuracy, wait thirty minutes after the unit is plugged in before making measurements.

4. Do not exceed the operating temperature specified for the 6000: from 0°C (32°F) to 40°C (104°F).

Instructions

1. Locate an AC power outlet with an operating voltage, frequency and connector compatible with your 6000. Operating with a grounded outlet is recommended.

2. Plug in the 6000; it should power up in the Standby mode, with all indicators off. Turn power on by pressing the STANDBY/ON switch. The unit should activate with 0.1 second gate time, A Input active, LO PASS FILTER out. The display should light showing a decimal point, all digits to the right of the decimal point and at least one digit to its left; assuming no input, all digits should be zero either immediately or after one measurement cycle.

3. The GATE OPEN LED should light several times per second.

4. Select which input, A or B, is appropriate to the range of measurements you wish to make. Measurements made of signals at frequencies less than 40 MHz must be made at the A Input. Measurements of signals at frequencies from 40 MHz to 100 MHz may be made at either A Input or the B Input; see the Applications section of this manual for additional information and advice on measurements of frequencies between 40 MHz and 100 MHz. Measurements of signals at frequencies from 100 MHz to

650 MHz should be made at the B Input.

5. Press the INPUT SELECT switch to activate the desired input, as indicated by the LEDs.

6. Make certain that the signals to be measured are within the amplitude and frequency ranges acceptable to the chosen input; the signal must not exceed the specified maximum input voltage. Also, note that the signal source should not be loaded by the 1 MΩ impedance at the A INPUT; signals at the 50Ω B INPUT should present a matching source impedance of 50Ω.

7. Connect the signal to be measured to the appropriate input BNC connector.

8. In some cases, direct connection may not be necessary. See the Applications section of this manual for additional information and advice on coupling signals to the 6000 inputs.

9. Select the gate time you wish to use by repeatedly pressing the appropriate button until the LED indicators advance to the desired time. Highest accuracy is attainable with the longest gate time (10 seconds); fastest updating speed is attainable with the shortest gate gate time (0.1 second). See the Applications section of this manual for additional information and advice on the appropriate selection of a gate time for a particular measurement task.

10. The display will indicate the frequency of the selected input signal in kilohertz.

11. The OVERFLOW LED will light if one of the following conditions occurs:

    * The B INPUT and 10 second gate time have been selected, and the input signal frequency is greater than 100 MHz. In this case, the display is accurately indicating eight digits of a nine-digit measurement (within limits of timebase accuracy); the most significant digit, corresponding to hundreds of megahertz, may be recovered by selecting a 1.0 second or 0.1 second gate time.

    * The A INPUT and 10 second gate time have been selected, and the input signal frequency is greater than 10 MHz. As above, the most significant digit is not displayed and may be recovered by selecting a 0.1 or 1.0 second gate time.

* The A INPUT and 1.0 second gate time have been selected and the input signal frequency is greater than 100 MHz. Again, selecting a 0.1 second gate time can recover the most significant digit.

12. For measurements of signals at frequencies below 60 kHz measurement errors may be substantially reduced by selecting the low pass filter. To do so, press the LO PASS FILTER switch in (see Precautions). This provides a low pass filtering function at 60 kHz, rolling off at 6 db/ octave. To restore unfiltered operation, press the switch again. The LED indicator is on when the filter is active.

13. The 6000 is a very capable instrument, but a thorough understanding of its capabilities requires more rigorous explanations of its various operating facilities. Many of these are provided in the Applications section of this manual.

TAKING RELIABLE READINGS

To take accurate, reliable readings you must:

1. Allow all equipment to "warm up."
2. Know the signal source characteristics.
3. Know the counter input characteristics.
4. Match the coupling between source and counter.

Signal Source Characteristics

The 6000 incorporates, as a standard feature, a pushbutton selectable low pass filter on the A Input. This is to be used in conjunction with the low frequency input to eliminate any high frequency noise that may be riding on a low frequency signal, causing the counter to give false readings.

The filter is activated by pressing the button marked LO PASS FILTER, and is indicated by a lit LED. It has a roll-off of 6 db/octave, starting at about 60 kHz.

This filter will also eliminate commonly-found noise spikes which can cause the counter to miscount.

If the transient spikes are severe, they can be eliminated with a small bypass capacitor (50-1000 pF) placed across the input leads.

Low frequency circuitry employs high impedances and is more sensitive to random power line spikes and external interference.

Using shielded cable will keep this problem at a minimum. Keep all unshielded cable as short as possible.

FUNCTIONAL DESCRIPTION

FIGURE 7 shows a block diagram of the 6000. It consists of 14 sections:

1. Low frequency input amplifier (5 Hz to 100 MHz)
2. Low pass filter
3. High frequency input amplifier (40 MHz to 650 MHz)
4. Prescaler
5. Input selection logic
6. First decade counter
7. Second decade counter
8. Main (8-digit) counter
9. Display and drivers
10. Crystal timebase
11. Timebase divider chain
12. Gate select logic
13. Gate/update logic
14. Power supply

The two front ends and the ÷10 prescaler (high and low frequency inputs) process the input signals. The input selection logic decides from which front end the counter will accept signals. These signals are passed through the decade dividers into the main counter where the measurements are sorted into digits and are updated periodically by the internal timebase. Once a measurement is ready for display, it is converted from binary code to display code and fed to the eight-digit seven-segment LED read-out.

The timebase section generates a precision gate pulse for the main counter and the required signals to process the input signal. Gate pulses of 0.1s, 1s, and 10s are switch-selectable.

The switch-selectable low pass filter attenuates signals above 60 kHz.

6000 BLOCK DIAGRAM

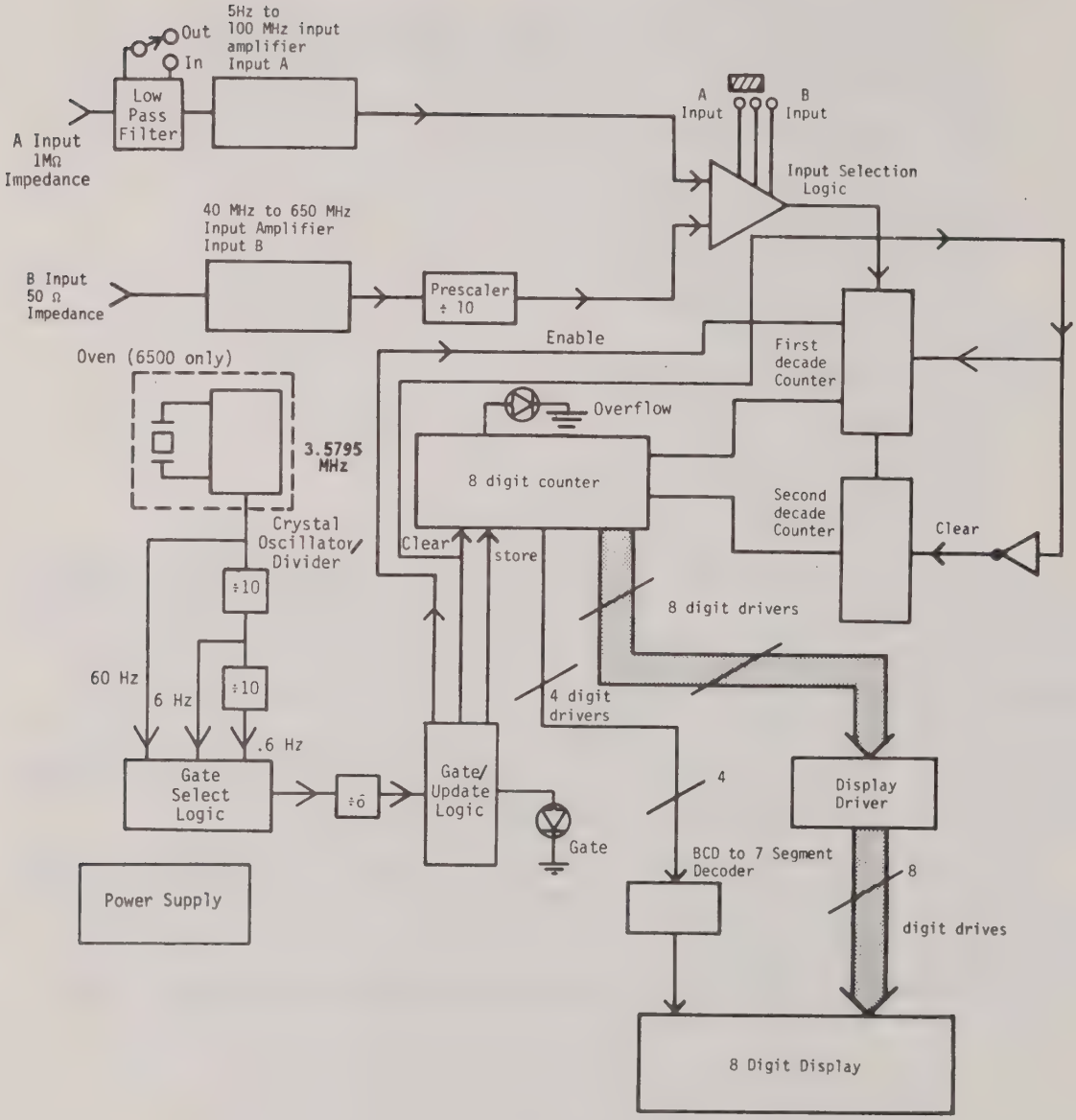


FIGURE 7

Refer to schematic.

Timebase

The timebase of a frequency counter controls the entire operation of the unit, and as such its accuracy affects the entire counter and its performance.

The 6000 uses a color burst crystal oscillator to activate the gate control and timing commands. In the Model 6500, this oscillator is kept at a constant 55°C to assure optimum stability across the entire operating temperature range. The heart of the oven is an LM3911 Temperature Controller I.C. configured as a proportional temperature controller.

The gate pulse starts as a precision 3.579545 MHz signal generated by a 3.579545 MHz crystal oscillator. This signal is then divided down to 60 Hz by U20. The 60 Hz is divided by ten twice by U19, making 6 Hz and 0.6 Hz available. U13 and U15 select which of these frequencies is fed to U14, where it is divided by six and fed to an RS flip-flop consisting of U9A and C, creating gate pulses of 0.1, 1, and 10 seconds.

FIGURE 8 shows a timing diagram with the series of pulses required to process the input signal. The top waveform shows a gate down time between points A and B, followed by a pulse. This is the count inhibit waveform that controls the decade counter after the front ends (U3, U4). Since all signals coming in must first pass through those dividers, control of the main counter (U6) can be achieved by switching these dividers on and off.

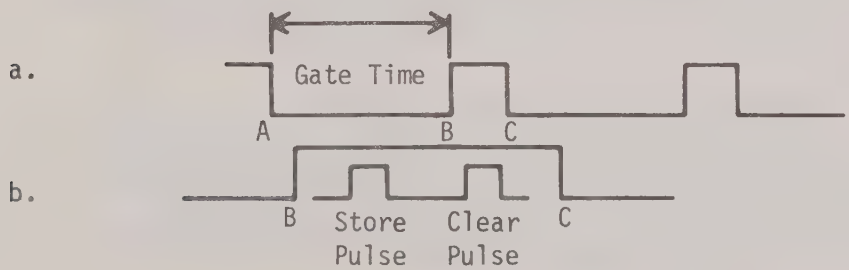


FIGURE 8

Assume that the main counter has been cleared and all digits are zero. At point A in FIGURE 8a the dividers are switched on and start to accumulate (count) incoming pulses. At point B in FIGURE 8a the dividers are switched off and all pulses that have entered it during this time interval have been sorted and stored in the main counter.

At this point the update cycle begins. FIGURE 8b shows the update wave in detail. Shortly after the start of the update pulse, a store pulse, created from the 60 Hz signal by U12 and U9B, commands the main counter to feed data into the storage latches. The latches now accept the new data. The latches will store the new data until the next store pulse.

Due to the manner in which the input signals are scanned, the display is always one measurement period (1 gate time) behind. This is not a major concern since the input frequency should be fairly constant.

Next, the reset pulse, created from the 60 Hz signal by U12 and U10D, causes all the counters to reset to zero and prepare for the next measurement cycle.

In asynchronous systems such as the 6000, there is an inherent ± one-count error. This occurs due to the random starting point of the timing cycle with respect to the input signal, i.e. the timing cycle can start just before or after one cycle of the input signal.

The front end of the counter connects to the signal source under test, and must therefore be able to withstand the wide range of conditions and still function properly.

The 6000 is equipped with two separate front ends:

Low frequency front end (5 Hz - 100 MHz)

The 6000 is equipped with diode-protected wide band FET preamp (Q8) that can withstand vast overloads and still continue to function properly, while the high input impedance of the FET allows it to couple to any circuit with a minimum of loading. Once the signal is past the FET, it is presented to a low noise preamp (Q7) and then to a series of line drivers that act as Schmitt triggers (U1). The signal is then fed to the input selection circuitry (U2A).

High frequency front end (40 MHz - 650 MHz)

The 6000 is also equipped with a special high frequency front end. The signal is fed into a high frequency, low noise preamp (Q24) and then into an ECL ÷10 prescaler chip (U5). The signal is processed and then fed into the input selection circuitry (U2D).

Input Select Logic

The input select logic consists of S2, U18, Q3, Q4, U2A, and U2D. The state of U18 alternates with each push of S2. Depending on the state of U18, either U2A or U2D is active, allowing the signal from the low frequency front end or the high frequency front end, respectively, to pass.

Either signal is then passed on to the first decade divider (U3 and U4) and then to the second decade divider (U7), and finally to the main counter (U6) itself.

Main Counter and Displays

The main counter (U6) is a 40-pin large-scale integrated circuit chip containing all latches and registers required to display an 8-digit binary coded decimal (BCD) output. It also contains the logic to produce an 8-bit "strobe system scan" oscillator, leading zero blanking system and overflow latch.

Here the data is processed as described previously...held in registers during the measurement period, and finally the new measurement is transferred to the display latches.

Each latch services one digit of the display and has four output lines. The display scanning logic sequentially samples the four lines. The displays are made up of seven individual LED segments per digit, which in combination can produce any number from zero to nine.

In order to produce a number on the display, the BCD outputs from the main counter must be converted into a code that is compatible with the 7-segment LED display.

A multiplexed display system is used. The system sequentially switches each 4-bit latch to the decoder and simultaneously turns on the associated display digit. Therefore, only one digit is active at any one time. The switching from digit to digit is extremely rapid and beyond the ability of the human eye to discern, thus the eyes "see" a continuous 8-digit display.

There is a two-fold benefit in multiplexing the LED displays: first, circuit simplification and second, an increase in the efficiency of the LED display. Since each digit is on only 1/8th of the time, in order to achieve the same brightness as a continuous display,the LED current must be increased eight times. Interesting results are produced via this process. LED efficiency increases with current, a pulsed LED giving off more light than a steady-state LED for the same average current. The human eye does not average pulsed light linearly. It tends to see pulsed light as actually brighter than it normally is, thus allowing the reduction in display current (which is a major portion of the power drain) and still maintaining a bright discernible display.

Power Supply

The unregulated +11 VDC supply applies power to the oscillator (and oven on

the 6500) as long as the 6000 is plugged into an active AC outlet, increasing the stability of the timebase. S1 is used to toggle U17, turning power on and off to the rest of the unit. The low frequency front end has its own +5V regulator (A2), and the crystal oscillator has its own +7V regulator (A3, R78, and R94), while the rest of the unit operates from another +5V regulator(A1).

Master Reset Feature

U9B and U10A, B, and D cause the display to reset to zero, clear all counters, and start a new measurement cycle whenever the GATE selector (S3) or the INPUT selector (S2) is activated.

APPLICATIONS

Signal processing
Transmit frequencies
Measuring RPM

Signal Processing

The front end of the Global Specialties 6000 Frequency Counter utilizes ECL logic to obtain high amplification with noise suppression circuitry to process the input signal source into a signal the 6000's counting logic can handle. As a user convenience, it has on its low frequency front end a low pass filter to eliminate high frequency noise that may be superimposed on low frequency signals.

This noise can come from many sources: static pickup, unterminated cables, RF fields, or ground loops, or the signal source itself may be noisy.

To help eliminate noise one can shield the cable, terminate the cable to stop ringing, break grounds to eliminate loops, and attenuate and filter the incoming signal.

An external attenuator can easily be added to the 6000 which will cut down both the signal and the noise. The counter will now read just the signal and ignore the noise. FIGURE 9 shows a table of various values for some common 50Ω π attentuators.

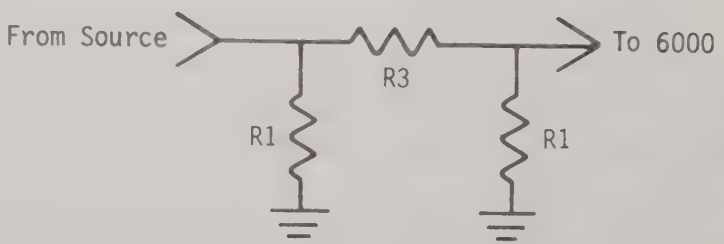
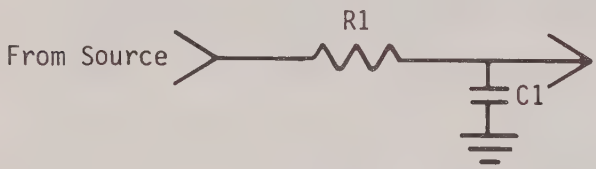


FIGURE 9

Attenuation in db	Shunt R1	Series R3
3 db	292	18
6 db	151	37
10 db	96	71
20 db	61	248

The 6000 incorporates a low pass filter for the low frequency front end with a roll-off at 60 KHz.

If a low pass filter is needed with a cut-off frequency other than 60 KHz, a simple low pass filter can easily be constructed. Use the following formula and diagram to design your filter:



$C1 = \frac{1}{2\pi R1f}$

f = Frequency of Roll-off

FIGURE 10

Example: Assume you need a filter to eliminate all signals above 100 KHz; the following values apply:

Typically assume R1 = 1KΩ

$$C = \frac{1}{(2)\ (3.14159)\ (1000)\ \ 10{,}000)}$$

$$= 15.9 \times 10\text{-}9$$

$$= 15.9 \text{ pF}$$

By inserting this into the input of the 6000 all frequencies above 10 kHz will be rejected while all frequencies below 10 kHz can be read.

Measuring Transmit Frequencies

The 6000 is a useful tool in the service and repair of CB, business ratio, ham radio, RCC, etc.

An antenna can be connected to either BNC input for quick testing of transmitters.

Measuring Audio Signals

The 6000 is useful in measuring audio as well as RF signals. It can read down to 5 Hz (guaranteed) with as much as 0.1 Hz resolution and its built-in low pass filter eliminates high frequency noise.

It can be used to test and calibrate function generators, tone burst oscillators, audio amplifiers, etc.

Measuring RPM

If the 6000 is used with 1 Hz resolution (1s gate time), 60 pulses per revolution will make it read directly in RPM with the correct decimal point. A 60-tooth wheel and transducer can be purchased from Dynapar Corporation, Gurnee, Illinois 60031. (When using this setup, use the low pass filter since transducers can be noisy.)

MAINTENANCE AND CALIBRATION

Fuse Replacement

The Model 6000 Frequency Counter uses a type 1/4 Amp, slow blow power fuse. The fuse post is mounted to the rear panel.

Timebase Calibration

The crystal oscillator used as a timebase within the 6000 (or the 6500) may be user-calibrated at any time, or may be returned to the factor for calibration to National Bureau of Standards station WWVB. (See Factory Service and Repair section of this manual.)

The timebase oscillator is tested, burned in, and calibrated at the factory prior to shipment.

To accomplish recalibration in the field, you will need a standard frequency source operating between 10 MHz and 100 MHz (10 MHz is used in the following examples), with an accuracy better than the crystal oscillator used in your counter. Since the accuracy of the oscillator is specified as being better than 4 ppm (0.1 ppm for the 6500), common engineering practice recommends that the calibration source be accurate to 0.4 ppm (0.01 ppm for the 6500), although adequate results can be obtained with 0.8 ppm (0.02 ppm for the 6500) accuracy.

The following is the recommended recalibration procedure for the 6000. (The procedure for the 6500 is the same, except for the tighter tolerances.)

1. Access to the trimmer capacitor can be made through the hole located in the vented section of the case bottom and a hole in the printed circuit board.
2. Plug the 6000 into the AC power outlet. This applies power to the oscillator (and oven). Also apply power to the frequency standard you have chosen for this calibration procedure.
3. The 6000 requires a minimum of thirty minutes to warm up and fully stabilize for maximum accuracy; your standard frequency source may require even longer warm-up time. Allow ample time for warm-up of both units.
4. Connect the external frequency standard to the A INPUT connector and select the A INPUT. Switch off the LO PASS FILTER.
5. Using a non-inductive, non-conductive tuning tool or wand, adjust the trimmer capacitor until the display indicates the frequency of the standard (expressed in kilohertz) within 0.1 ppm; at 10 MHz, the display should read as follows:

   0.1 second gate time -
   not recommended
   1.0 second gate time -
   between 9999.999 and 10000.001
   10 second gate time -
   between 9999.9990 and (OVERFLOW LED on) 0000.0010

6. Wait five minutes and check the displayed frequency again, comparing it against the best calibration you were able to obtain in Step 5. If there has been any change, follow the procedure in Step 5 again, adjusting the trimmer capacitor to give you a display halfway between the new reading and the frequency of your standard.
7. Repeat Step 6 as necessary until you obtain stable, precise results. It is more than likely that Step 6 will prove unnecessary, and that the calibration you obtain in Step 5 will remain stable.
8. This completes calibration of your 6000.

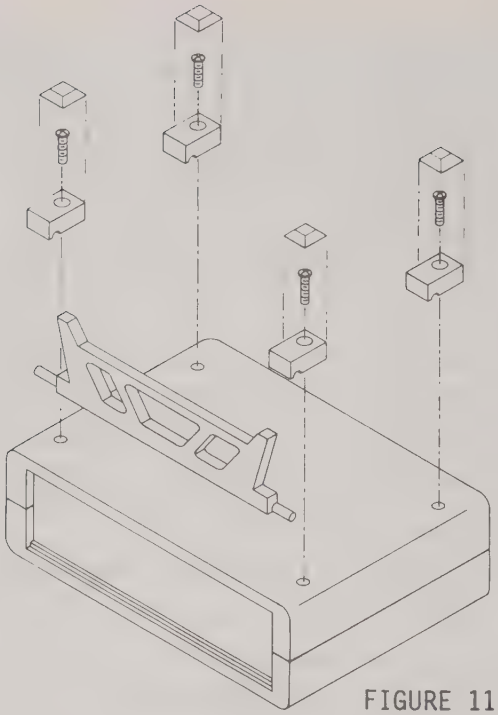


FIGURE 11

Case Disassembly (See FIGURE 11)

1. Remove all input cables.
2. DISCONNECT LINE CORD FROM AC OUTLET!
3. Turn the 6000 upside-down on a soft surface to prevent scratching the top of the case.
4. Remove the stick-on rubber feet from the foot assemblies. Place aside, non-sticky side down.
5. Remove the Phillips-head screw from each of the four-foot assemblies.
6. Remove the foot assemblies and the flip-up leg.
7. Keeping the top and bottom case halves together with light pressure, carefully turn the case upright.
8. Gently slide the top half of the case straight upward until it is clear of the unit. The P.C. board should now be visible.
9. The P.C. board can be removed by removing the self-tapping screw from the center of the P.C. board, and lifting the P.C. board, front panel, and rear panel straight upward as a unit. Note that the display board, front panel, and rear panel remain wired to the P.C. board.

Case Reassembly (See FIGURE 11)

1. Make sure no tools or debris remain inside the case, and that all power and input connections are removed.
2. If the P.C. board, etc. have been removed, replace them as follows. Align the front panel over the LEDs and switches on the display board. As a unit, slide the front and rear panels into the appropriate grooves in the bottom half of the case, while allowing the main P.C. board to drop into the case. Replace the self-tapping screw in the center of the board, being sure that the holes in the four corners of the board are aligned over the holes in the corresponding bosses before tightening this screw.
3. Gently slide the top case half straight down into position atop the bottom case half. Make sure the front and rear panels are in position in the case panel grooves.
4. Keeping the top and bottom case halves together with light pressure, carefully turn the case upside-down.
5. Position the flip-up leg and foot assemblies.
6. Replace the Phillips-head screw in each foot assembly. Do not overtighten.
7. Replace the stick-on rubber feet.
8. Return the 6000 to its upright position.

SERVICE AND WARRANTY INFORMATION

FACTORY SERVICE AND REPAIR

Global Specialties will service and repair this instrument free of charge for a period of one full year, subject to the warranty conditions below.

To obtain a return merchandise authorization (RMA) required for all returns, phone our Customer Service Department for an RMA and all shipping instructions: Tel. 800-572-1028
or write:

GLOBAL SPECIALTIES
70 FULTON TERRACE, BOX 1942
NEW HAVEN, CONNECTICUT 06509
ATTN: CUSTOMER SERVICE DEPARTMENT
1-800-572-1028

WARRANTY

Global Specialties warrants this device to be free from defective material or workmanship for a period of one full year from date of original purchase.

Global Specialties under this warranty is limited to repairing the defective device when returned to the factory, shipping charges prepaid, within one full year from date of original purchase.

Units returned to Global Specialties that have been subject to abuse, misuse, damage or accident, or have been connected, installed or adjusted contrary to the instructions furnished by Global Specialties, or that have been repaired by unauthorized persons will not be covered by this warranty.

Global Specialties reserves the right to discontinue models, change specifications, price or design of this device at any time without notice and without incurring any obligation whatsoever.

The purchaser agrees to assume all liabilities for any damages and/or bodily injury which may result from the use or misuse of this device by the purchaser, his employees, or agents.

This warranty is in lieu of all other representations or warranties expressed or implied and no agent or representative of Global Specialties is authorized to assume any other obligation in connection with the sale and purchase of this device.

BREADBOARDING SOCKETS LIFETIME GUARANTEE

All Global breadboarding sockets are guaranteed for life. If a socket ever fails to meet your requirements, return it and we will replace it, NO QUESTIONS ASKED.

Specifications subject to change without notice.
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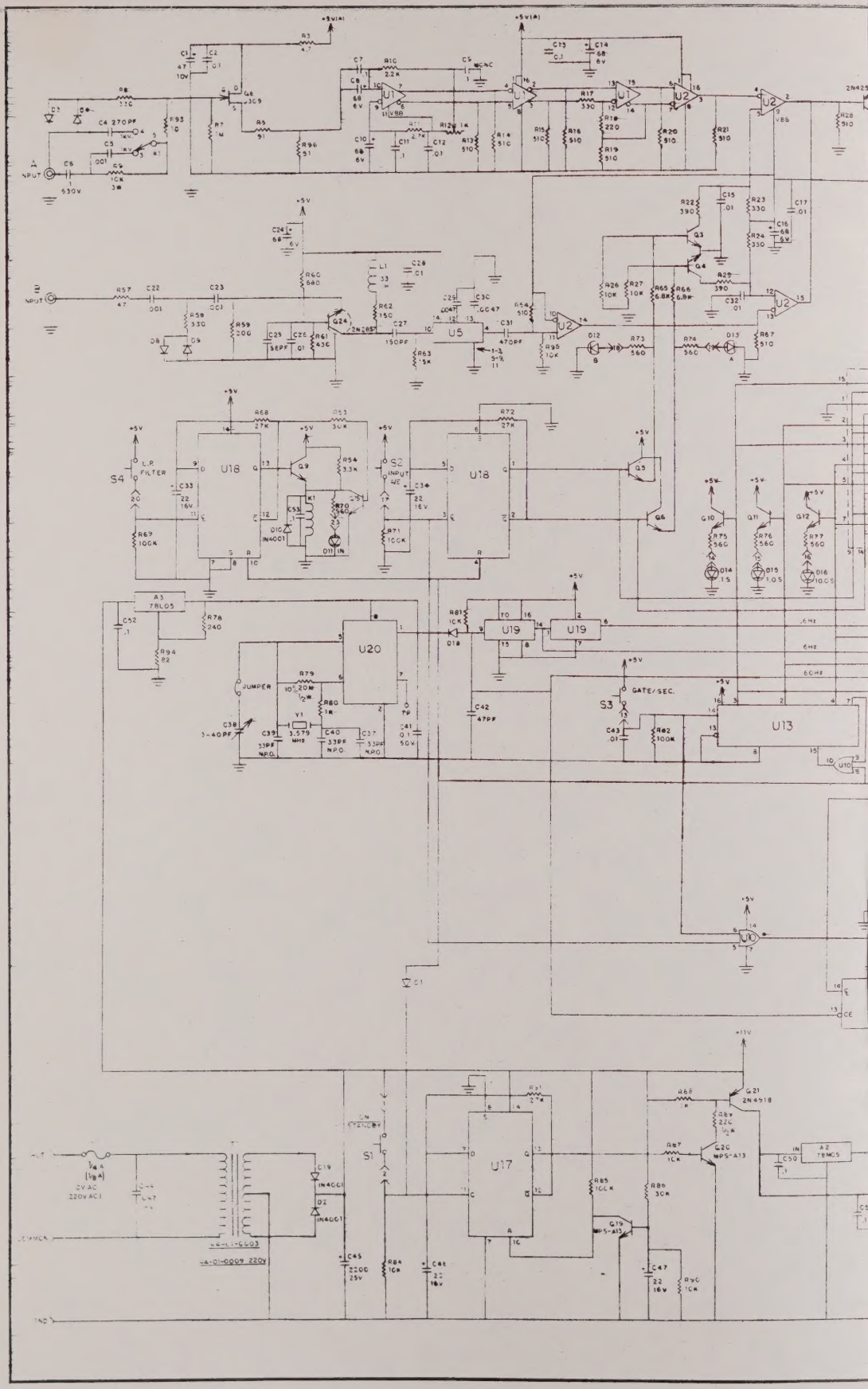

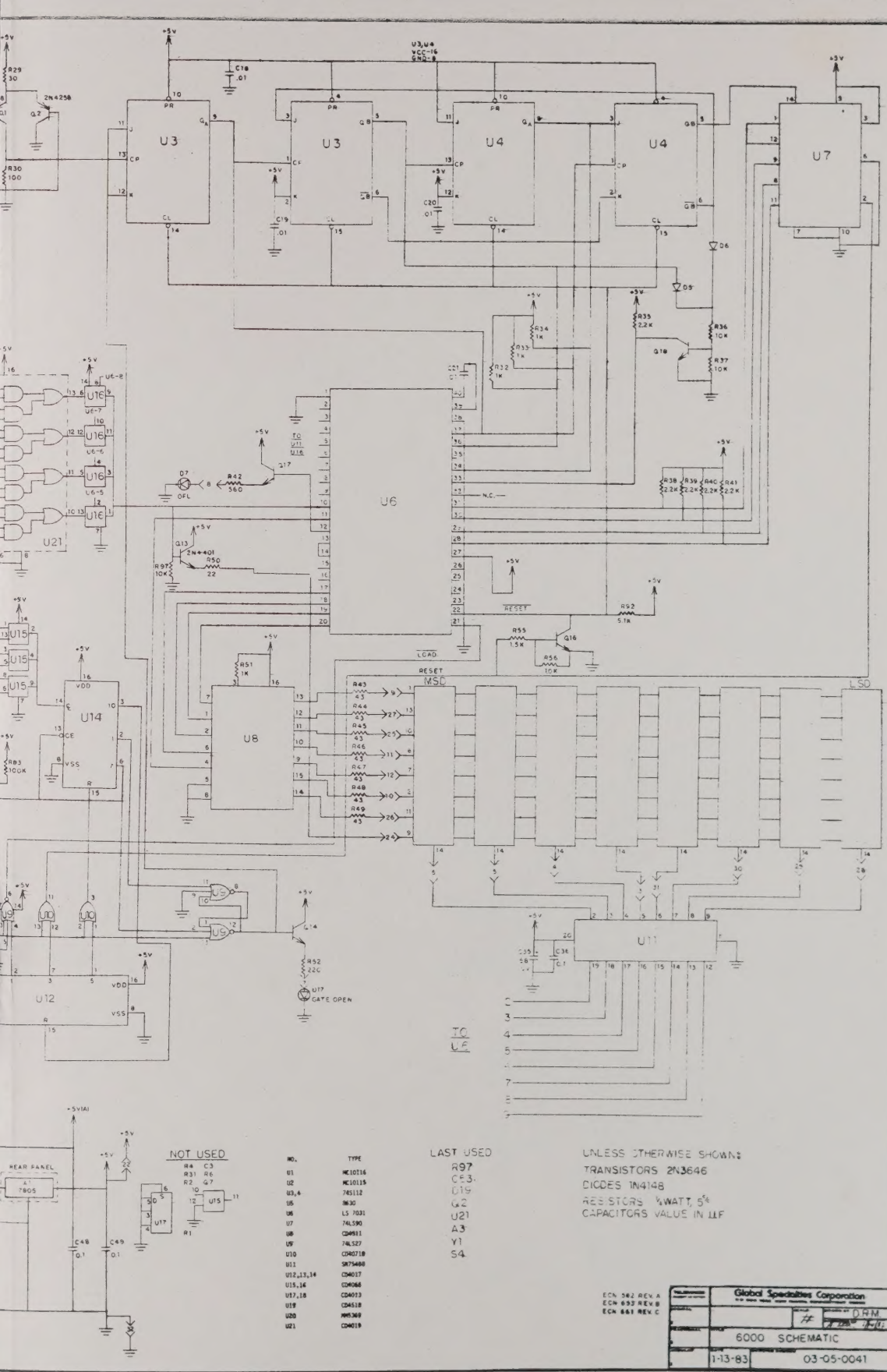

NO.	TYPE
U1	MC10116
U2	MC10115
U3,4	74S112
U5	3630
U6	LS 7031
U7	74LS90
U8	CD4511
U9	74LS27
U10	CD4071B
U11	SN75468
U12,13,14	CD4017
U15,16	CD4066
U17,18	CD4013
U19	CD4518
U20	AM9369
U21	CD4019

LAST USED
R97
CE3.
D19
G2
U21
A3
Y1
S4

UNLESS OTHERWISE SHOWN:
TRANSISTORS 2N3646
DIODES 1N4148
RESISTORS ¼WATT, 5%
CAPACITORS VALUE IN UF

ECN 582 REV A
ECN 653 REV B
ECN 661 REV C

Global Specialties Corporation

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	6000 SCHEMATIC
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